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10/807,103	03/24/2004	Koichi Matsuda	03500.017972.	2515

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EXAMINER	
MERSHON, JAYNE L	

ART UNIT	PAPER NUMBER
1795	

MAIL DATE	DELIVERY MODE
12/23/2009	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/807,103	MATSUDA ET AL.	
	Examiner	Art Unit	
	Jayne Mershon	1795	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *09 September 2009*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-8,12 and 13* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-8,12 and 13* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *10/13/2009*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application.
6) ☐ Other: _____.

DETAILED ACTION

Status of Claims

Claims 1-8, 12 and 13 are pending. Claims 9-11 and claims 14-17 have been canceled. Claims 1-8, 12 and 13 are examined below.

Response to Amendment

Applicant's amendment submitted 9/9/2009 does not render the application allowable.

Status of the Rejections

Previous rejections have been maintained in view of applicant's amendment.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

1. Claims 12 and 13 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Specifically, the limitation of the claim states two layers are stacked and the second layer is formed faster than the first layer. But the method of forming is not stated and the order of forming is not stated, i.e. the second layer can be formed first and the first layer can be formed second since the only limitation is that the first layer is in contact with at least one interface. It is indefinite as to what the rate refers to, i.e. does it mean the rate is faster for a sol gel method, a spin coat method, an ion beam epitaxial method (see instant application paragraphs [0088] and [0095]). The rate could refer to the rate of drying, the rate of fusing, the rate of spraying, etc. Nowhere does it say the two layers must be formed by the same method.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

1. Claims 1-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sano et al. (US 6180870) in view of Ishihara et al. (US 5021100) and further in view of Nakajima et al. (JP 2000150934).

As to claim 1, Sano et al. show a stacked photovoltaic element (stack type photovoltaic device, depicted in Figure 1) comprising a plurality of unit photovoltaic elements (top cell, 150, middle cell, 140, and bottom cell, 130) each composed of a pin- junction ("pin structures", column 5, line 31), connected to each other in series (as shown in Figure 1). Sano et al. is silent as to a zinc oxide layer being provided between two consecutively stacked unit photovoltaic elements.

Ishihara et al. disclose a stacked photovoltaic element ("multiple cell photovoltaic device", Figure 1) that contains an upper solar cell (second solar cell, 12) and a lower solar cell (first solar cell, 11) and that are separated by a selective reflection film (ZnO) (8). As Ishihara et al. explain in column 2, lines 42-47, the purpose of the selective reflective film is to reflect short wavelength light which may be absorbed by the upper solar cell (12) and to transmit long wave-length light which is not absorbed by the upper solar cell (12) and may be absorbed by the lower solar cell (first solar cell, 11). Ishihara et al. teach in column 2 lines 47-51 that this increases the photocurrent generated in the upper cell without reducing the current generated in the lower cell "thereby balancing the photocurrents in the respective cells." Ishihara et al. further teach that the material for the selective reflection layer may be zinc oxide (ZnO) in column 4, line 54.
It would have been obvious to one of ordinary skill in the art at the time of the invention to provide the selective reflection layer (instant zinc oxide layer) of Ishihara et al. between each of the photovoltaic elements of Sano et al. (i.e., at the junction in which 150 is the upper cell and

140 is the lower cell, and at the junction in which 140 is the upper cell and 130 is the lower cell) in order to increase the photocurrent generated in the lower cell without reducing the current generated in the upper cell and thereby balance the photocurrents in the respective cells.

What the zinc oxide layer selective reflective layer of Ishihara et al. (and, therefore, the modified device of Sano et al.) fails to provide is that the resistivity of the zinc oxide selective reflection layer varies in the direction of its thickness.

However, Nakajima et al. disclose photovoltaic cell (Drawing 1) that contains a zinc oxide diffusion barrier layer (4) with a non-uniform concentration of metallic impurities (e.g., 1-3 wt. % aluminum, paragraph 0013). As Nakajima et al. explain in paragraph 0004, the addition of metallic impurities such as aluminum or gallium to the zinc oxide layer raises the conductivity of this layer and leads to an improved junction between the zinc oxide layer (4) and subsequent photo-electric conversion layers (3) of the device. The concentration of metallic impurities in the zinc oxide layer is chosen to be non-uniform (i.e., greater at the end of the zinc oxide layer that contacts the photo\- electric conversion layer than at the opposite end of the zinc oxide layer) so that the said junction may be improved without compromising the light-transmissive properties of the zinc oxide layer (paragraph 0004). Nakajima et al. further teach that this non\- uniform concentration may be either composed of "a plurality of layer constitutions having different impurity concentrations" or be a single layer with a "graded" impurity concentration (abstract). Any such graded concentration of metallic impurity along the direction of the thickness of a zinc oxide film would necessarily create a corresponding gradient in the resistivity of said film given that the presence of the metallic impurity increases the conductivity of the zinc oxide (paragraph

0004). Examiner note: Nakajima provides a reflective metal layer (5) opposite the incident light side of the cell (bottom/1).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to provide the non-uniform impurity concentration of Nakajima et al. to the zinc oxide selective reflection layers of the modified device of Sano et al. such that the end of the zinc oxide film with the higher concentration of metallic impurity would be at the junction between the n-layer of 150 and the zinc oxide selective reflection layer separating 150 from 140, and at the junction between the n-layer of 140 and the zinc oxide selective reflection layer separating 140 from 130 in order to improve the junction between the zinc oxide layer and subsequent photo-electric conversion layers of the device without compromising the light-transmissive properties of the zinc oxide layer and as such is clearly within purview of one of ordinary skill in the art.

As to claim 2, applying the impurity concentration of Nakajima et al. to the modified device of Sano et al. as described above would necessarily create a zinc oxide layer with a lower resistivity on the side of the zinc oxide layer that is in contact with the n-layer of each of the upper photovoltaic devices (i.e., 140 and 150).

As to claim 3, applying the graded impurity concentration of Nakajima et al. to the modified device of Sano et al. as described above would necessarily create a continuous decrease in the resistivity of the zinc oxide from the side in contact with the p-layer of the upper photovoltaic device towards a side of the zinc oxide layer in contact with the n-layer of the lower photovoltaic device. This is so because the resistivity is inversely related to the concentration of metallic impurities which, as described above, would continuously increase in the zinc oxide

layer from the side in contact with the p-layer of the upper photovoltaic device towards a side of the zinc oxide layer in contact with the n-layer of the lower photovoltaic device.

As to claims 4 and 5, one of ordinary skill in the art would tailor the concentration of metallic impurities in the graded impurity concentration of Nakajima et al. provided to the modified device of Sano et al. as needed in order to improve the junction between the zinc oxide layer and the subsequent photo-electric conversion layers of the device as instructed in by Nakajima et al. in paragraph 0005. Although Nakajima et al. do not report the sheet resistance of the layer, it has been shown that a few atomic % of AI- doping of zinc oxide films can give sheet resistances well within the range of claim 4 (i.e., 2x10° Ocm and 5x103 Ocm) or claim 5 (5x102 Ocm and 5x103 Ocm). For this see Figure 1 of Rabadanov et al. (R. A. Rabadanov, M. K. Guseikhanov, I. Sh. Aliev and S. A. Semiletov, "Properties of metal-zinc oxide contacts", Izvestiya Vysshikh Uchebnykh Zavedenii, Fizika, 6, 72-75 (1981)).

As to claim 6, Sano et al. state that the i-type layer (113) of the uppermost cell (150) may be composed of amorphous silicon in column 8 lines 6-8. Sano et al. further specify that said amorphous silicon may be a-Si-H in column 8 line 41.

As to claims 7 and 8, Sano et al. state the i-type layer (110) of the middle cell (140) is composed of microcrystalline silicon in column 8, line 9. Since microcrystalline silicon is a form of polycrystalline silicon, the same line indicates that the i-type layer of the middle cell may be composed of polycrystalline silicon.

2. Claims 12 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yamashita et al. (JP 2003188401 A) in view of Kohiki et al. (US 6,787,069).

Regarding claims 12 and 13, Yamashita et al. teaches a stacked photovoltaic element comprising an intermediate layer between unit photovoltaic elements each having a pn-junction or a pin-junction (see paragraphs [002]-[003] and [0010]).

Furthermore, Yamashita et al. teaches stacking a first layer mainly composed of indium oxide, i.e. indium tin oxide (ITO), on at least one interface with the unit photovoltaic element (specifically the substrate side), and stacking a second layer mainly composed of zinc oxide on and in direct contact with the first layer of ITO (see paragraphs [0012]-[0013]).

Yamashita et al. does not disclose that the layer identified as the second layer (i.e. the zinc oxide layer) is formed at a rate higher than that of the first layer (claim 12).

Yamashita et al. does not disclose that the layer identified as the second layer (i.e. the zinc oxide layer) is formed at a lower temperature than that of the first layer (claim 13).

Kohiki et al. teach a method for depositing indium oxide that is at a slower deposition rate and higher temperature than the method used for depositing zinc oxide (see col. 7, lines 4-22 and col. 8, lines 10-42), i.e. the indium oxide layer is stirred 24 hours, dried and baked for one hour at 900C while the zinc oxide is sputtered without heating in less than 24 hours. The doping of the zinc oxide is carried out after the high rate, low temperature deposition of the zinc oxide. Since the claim language is silent as to method of forming, the layers can be subsequently transferred or fused.

Therefore, it would have been obvious to one of ordinary skill in the art to modify the layers of Stanbery by depositing the layers by known methods where the zinc oxide is deposited at a faster rate and lower temperature than the indium oxide because such techniques are well known and function to deposit the two layers.

Response to Arguments

Applicant's arguments filed 9/9/2009 have been fully considered but they are not persuasive.

Regarding applicant's argument that the combination of Nakajima with Sanyo/Ishihara does not have a proper motivation, Nakajima states adding impurities to the ZnO creates a better ohmic contact. But, adding impurities also degrades the transparency. By decreasing the impurities within the thickness of the ZnO layer, the transparency could be better maintained. Maintaining transparency is desirable, therefore applicant's argument is not persuasive.

Regarding applicant's argument that even with motivation to combine Nakajima, the examiner's rationale for the ordering of the conductivity, i.e. more conductive to the lower cell, is overly broad, the applicant is disregarding the engineering ability of one skilled in the art. The function of the n-type layer which is the electron transport, would be known to one skilled in the art.

Moreover, even if an engineer's skill would not have immediately led to the specified structure, there are a limited number of grading concentrations available.

The court has ruled that "when there is motivation to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to anticipated success, it is likely the product not of innovation but of ordinary skill and common sense." See *Ex parte Kubin*, 83 USPQ2d 1410 (Bd. Pat. App. & Int. 2007). See also MPEP § 2141. With the

motivation to improve light transmittal, it would be obvious to try the available finite variation in conductivity.

In regards to applicant's arguments regarding claims 12 and 13, that the combination of Ishihara and Mahan teach the recited structure. First, Mahan is used simply to teach that doping concentration is controlled by heat and deposition rate, therefore a person having ordinary skill would control the doping one or both of those variables, resulting in heat and deposition rate as result effective variables (see MPEP § 2144.05).

Second, when the applicant states Ishihara does not teach the recited structure, applicant is arguing the amended claims. Therefore the argument is moot. See new grounds of rejection.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Yamashita et al. (JP 2003188401 A). Note: It is the examiner's position that the JP publication cited, submitted by the applicant in the IDS dated 10/13/2009, teaches all the limitations of independent claim 1 as well as independent claims 12 and 13. Since this was a final rejection and claim 1 was not amended, the rejection was not modified to include the prior art submitted by the applicant.

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after

the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jayne Mershon whose telephone number is (571) 270-7869. The examiner can normally be reached on 9:00 AM to 5:00 PM; alt. Fridays off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jennifer Michener can be reached on (571) 272-1424. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

JLM
12/10/2009
/Jennifer K. Michener/
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